

THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 21. SEPTEMBER 1889.

XXI.—*On the Organism of the Siphonophora and their Phylogenetic Derivation: a Criticism upon E. Haeckel's so-called Medusome-theory.* By Professor CARL CLAUS*.

As is well known, opinions as to the interpretation of the Siphonophora diverge in two directions, a number of naturalists regarding them, after the example of C. Vogt and R. Leuckart, and in accordance with the latter's theory of polymorphism, as free-swimming Hydroid-stocks with Polypoid and Medusoid individuals, while other zoologists adhere to the older conception of Eschscholtz and Huxley, and, aided by the image of a proliferating *Sarsia* (Metschnikoff), refer the organism of the Siphonophore to the Medusa. I endeavoured, as long since as 1860 †, to demonstrate the correctness of the former view; but more recently, in two memoirs, I have pointed out what is common to the two theories and sought to combine them. The same thing has lately been done, although partly from other points of view, by Haeckel in his 'Report on the Siphonophoræ collected by H.M.S. 'Challenger' during the years 1873-76,' so rich in descrip-

* Translated from a separate copy, furnished by the Author, of the memoir published in the 'Arbeiten des Zoologischen Instituts der Universität Wien,' tom. viii. Heft ii. pp. 159-174 (1889).

† "Ueber *Physophora hydrostatica*," in Zeitschr. f. wiss. Zool. Bd. xii. *Ann. & Mag. N. Hist.* Ser. 6. Vol. iv.

tions of interesting and previously unknown forms, as also in a previously issued extract from this work*, in which he develops a mediatory theory, uniting, in the opinion of its author, the true constituents of the two older theories, whilst eliminating their errors, and for the first time revealing the true nature of the Siphonophora.

Haeckel has very cleverly succeeded in giving an appearance of novelty and speciality to his "*Medusome-theory*," as he calls it, by placing in the foreground, in the definition of the two theories, certain subordinate points, and, in accordance with this, employing new designations which conceal the *essence* of the theories. The first is indicated as the *poly-person* theory, the second as the *poly-organ* theory; and it is asserted of the two that they are still, as formerly, in absolute opposition to each other. According to the latter the Siphonophore is a simple Hydromedusoid person, therefore a morphological individual of the third order; while according to the other, which affirms the derivation from polypes, it is a swimming hydropolyp stock or a morphological individual of the fourth order. Such a conception, however, by no means represents the true state of affairs, but is a one-sided representation, obscuring the essence of the question, which, in the light of our notions as to the relation of Medusa and Polype, obtained by more recent investigations, must be regarded as incorrect.

In accordance with these notions the theory of polymorphism founded by Leuckart could by no means be sustained unaltered in its old form and conception; and just as the supposed absolute opposition of poly-persons and poly-organs has long since been swept away, it is also no longer admissible to deduce from the reference of the Siphonophore to a swimming Hydroid stock "the philosophical corollary that the whole class sprang from Polypes."

Any one who is to some extent informed upon the subject of the Coelenterata will at once see that the theory which in the Siphonophore goes back to the Medusa, and which therefore may perhaps be best designated the *Medusa-theory*, also by no means involves as a necessary conclusion that the Siphonophore is to be regarded as an individual of the third order in Haeckel's sense. For, although the starting-form for the morphological formation of the larva is a Medusa from which, by continual gemmation of new Medusæ or parts of Medusæ, the appendages of the Siphonophore were developed, the Siphonophore, in the same way as the *Sarsia*-stock

* "*System der Siphonophoren auf phylogenetischer Grundlage*," in *Jenaische Zeitschr. f. Naturw.* Bd. xxii. (1888).

which is produced by the proliferation of daughter-Medusæ upon the parent animal, must, by the sprouting forth of a great number of new Medusæ and their dislocated parts upon the body of the primary Medusa, become a stock or cormus, an individual of the fourth order in Haeckel's sense. The central point of the controversy lay, not in the question between person and animal-stock, but in the issue, prescriptive as to the interpretation of the larva, from the Hydromedusa or from the *swimming Hydroid-stock*. But even in the latter case the Hydromedusa continues to be the sexual animal giving origin to the stock. It is therefore a serious error for Haeckel to assert of this second theory, which we shall designate the *Hydroid-theory*, that it deduces the origination of the latter from the Polypes, and is therefore compelled to conceive of all the *swimming-organs of the Siphonophora as new formations*.

From these considerations, which have already been repeatedly adduced by me, we see how incorrect is the assertion that the two theories still stand in direct opposition. Eleven years ago, in a special chapter of my memoir on *Halistemma* * bearing the title "Ueber die Auffassung der Siphonophoren als polymorphe Thierstöcke," I have shown the relation between the two theories, and demonstrated that they are by no means sharply and irreconcilably opposed to each other. In the same way five years afterwards, in a small paper "On the Phylogenetic Development of the Siphonophora" †, I have laid down the position of matters and indicated that even the *Hydroid-theory*, which takes the swimming Hydroid-stock as the starting-point of the comparison, presupposes as the stem-form the Medusa as the sexual animal from which it originates, and consequently attempted a reconciliation in both directions, with reference both to the conception of polymorphism and animal-stock and to the stem-form of the Medusa. Haeckel has entirely ignored the contents of both these memoirs as regards this question, although, to my surprise, he quotes the former, but does not esteem it necessary even to cite the second in the list of papers appended to his work. Had he taken them into consideration it would certainly have been impossible for him to teach that there at present exists a direct opposition between the poly-person and the poly-organ theory, or to represent his *Medusome-theory*, which, in reality, coincides

* "Ueber *Halistemma tergestinum* &c.," in den Arbeiten des Zool. Inst. zu Wien, tom. i. (1878).

† *Ibid.* tom. v. (1883).

with the Medusa-theory, as a new theory reconciling the two.

Under these circumstances I may venture to reproduce some passages which are decisive upon the present question, especially as the statements made in both memoirs seem to be but little known generally.

In the above-cited chapter of my memoir on *Halistemma* the arguments which are in opposition to the Medusa-theory of Huxley and Metschnikoff are first of all discussed. Then it is said (p. 48):—"But the very tendency to the repetition of similar organs which Metschnikoff is obliged to ascribe to the Siphonophoran organism carries him from his different starting-point (Medusa) back again to the theory of polymorphism, which he thinks he has confuted so very decidedly. For in reality if a second bract or a new nectocalyx, a second or third polyp or feeler be added, the stem of the primary stomach or Medusan stomachal peduncle becomes, I readily admit, like a *Sarsia prolifera*, a kind of proliferating stem with many hundreds of appendages. But by this, at the same time, the conception of the Siphonophore as a *multiplicity of repetitive Medusan parts, purposely reduced Medusæ with special functions, is manifested, and the theory of polymorphism and of the division of labour is perfectly confirmed*, for if the buds on the stomachal peduncle of *Sarsia* here brought into comparison shape themselves into new Medusæ, and therefore are morphologically the foundations of new individuals, the same applies to the sprouting Siphonophoran appendages, whether these, as genital nectocalyces, assume the perfect Medusan form, or as feelers and polype (gastric sac), relatively as nectocalyx and bract, merely reproduce parts of Medusæ, *i. e.* reduced Medusæ, and consequently are only able to perform parts of the functional work.

"The difference of Leuckart's interpretation of the Siphonophoran body as a polymorphic free-swimming Hydroid-stock *therefore fundamentally relates only to the starting-form*, which Leuckart, in accordance with the then existing state of the theory of development, thought was to be recognized in the larva which, as an isolated gastric sac, founded the colony, whilst, according to the more recent views of developmental history, it appears to be represented by the parts of a Medusa.

"But if, as the results of later investigations will perhaps furnish decisive data to show, the morphologically higher Hydroid-form, the Medusa, be really the starting-point in the production of the Siphonophore, the polymorphism of our

organisms, now to be designated as Siphonophora ("Röhren-quallen"), which acquire the character of Hydroid-stocks, would not, as the preceding remarks have shown, be in the least degree contradicted; but rather their appendages, according as they repeat the stomachal peduncle (polypites) or the Medusan umbrella, and relatively both segments in a simplified form (sexual buds), would be now as before characterizable as *Polypoid* and *Medusoid* individuals in Leuckart's sense. But as we have already ascertained that the *Polype* and *Medusa* are fundamentally one and the same*, the difference expressed in the two conceptions would be of significance only with regard to the phylogenetic relations of the Siphonophora.

"Moreover it is evident, as may also be deduced in the same way from the morphology and developmental history of the Cestodea, that the ideas of the individual and animal-stock in the lower animals are by no means morphologically sharply defined and opposed to each other in Haeckel's sense of 'person' and 'cormus,' but must be regarded only as *relative ideas* in the same way as those of 'organ' and 'individual,' and vary in their application according to the objects compared. Therefore, also, Leuckart's criterion, which is supposed to prove the individuality of all the Siphonophoran appendages, namely their similarity of constitution in the bud-state, cannot in this sense be in the least degree accepted. By it the marginal filaments of the Medusan umbrella, the tentacles of a Scyphistoma, or of any polyp would also be shown to be individuals. This certainly unmistakable contradiction, which, however, is at once got rid of by the conception of the individual and stock as relative ideas, appears to have been Metschnikoff's principal inducement to oppose the theory of polymorphism and, so to speak, empty out the baby with the bath."

In the subsequent smaller paper I expressed myself no less definitely (p. 9) upon the relation of the two views and the possibility of combining them as follows:—"I have already (in the memoir on *Halistemma*) endeavoured to show that the difference between the two conceptions, especially considering the relative value of the idea 'Individual' and the relation of the Medusa to the Hydroid-stock as the sexual animal produced by the latter, is by no means so considerable as it seems to be at the first glance, and that even the second con-

* In a previous passage of the same memoir (pp. 26-30) the morphological derivation of the nectocalyx, Hydroid Medusa, and Acaleph from polypes was genetically established.

ception (Medusa-theory) *does not in the smallest degree alter the theory of polymorphism.*"

When, therefore, Haeckel objects to the Medusa-theory that it ascribes to the developed Siphonophoran cormus only the value of a "person" and regards the persons which constitute it only as organs (in the morphological sense), it has escaped him that I had already repeatedly shown how little any such deduction is founded in the theory itself, inasmuch as, in full accord with the requirements of his Medusome-theory, *it has to regard the developed Siphonophore as a cormus composed of numerous polymorphic persons.* When he further asserts of the Hydroid-theory that it goes too far and is wrong in ascribing to the different (morphological) organs of these persons the same value, he has forgotten to say that these deficiencies were already removed by the explanations given in these memoirs, and no longer existed in the conception of the theory supported by me, so that there was already a reconciliation of the two theories by which the supposed abrupt opposition between them had been cancelled. But had Haeckel taken account of the contents of my papers, not only would the reconciliation contained in his Medusome-theory have lost the appearance of novelty, but the essential thing, the true nature of the opposition of the two previous theories, and at the same time the coincidence of his Medusome-theory with the Medusa-theory, would have come to light.

It was, however, consistent that Haeckel, in consequence of a representation made to him by Metschnikoff relating to the interpretation* of the Siphonophoran larva as a Medusa, was converted from the theory of Vogt and Leuckart, of which he had previously been a zealous adherent, to the Medusa-theory and transferred to this the polymorphism of the former. Nevertheless we might have expected from him at least a statement of the reasons why a swimming polyp-stock could not have been the phylogenetic origin of the Siphonophora, more especially as of late several arguments in favour of this view and in contradiction to the Medusa-theory have been brought forward. Instead of clearing away the difficulties raised by R. Leuckart and afterwards by myself and others, which are offered to this theory by the supposed dislocation of many parts of Medusæ, and confuting the objections raised by me to the assumption that the sexual form of the Hydroid polype in its perfected form as a Medusa furnished the starting-point for the production of the Siphonophora, a series

* "Studien über die Entwicklung der Medusen und Siphonophoren," in Zeitschr. f. wiss. Zool. tom. xxiv. (1874) p. 38.

of assertions are posited as axioms and adopted as established propositions in the schematization of the new Medusome-theory.

How does Haeckel prove to us that the primary Medusiform Siphonophoran larva is to be interpreted *palingenetically*, and demonstrate the truth of the assumption of an extensive multiplication and dislocation of the individual organs of the Medusa? And to what new factual conditions does he appeal when, as arbitrator in this main question, he rejects as erroneous the opposite view, which denies a far-reaching secondary multiplication and dislocation of these organs, and regards the primary Medusiform larva as a cænogenetic form? Or is it more than an axiom to start from a bilateral Medusa as the primary larva or "siphonula," which, distinguished by a ventral umbrellar fissure and the possession of a single marginal filament, has originated from a primæval bilateral stem-form of the Anthomedusan group, to be christened "Proto-meda"? How long, in Hæckel's system, has the bilateral symmetry, which, according to his Gastræa-theory, is produced as a consequence of a creeping mode of life, been thus a primitive character of the Medusa, the ontogenetic development of which on the Hydroid-stock would indicate a regular radiate fundamental form?

By such a dogmatic assertion, at variance with all observation, we certainly escape answering the question * in what manner the stomachal tube and tentacles have passed from the centre and the umbrellar margin to the outside of the Medusan umbrella, and what advantage this deviation from the radiate fundamental form could have had for the maintenance of the organism, but without considering that in this way the knot has been cut and not loosened.

It is the same with the second axiom, which gives Haeckel's Medusa-theory its special character, namely the assumption of a second primitive stem-form of octoradial structure of the Trachymedusan group, called the "Archimeda," in order to derive therefrom a second Medusiform larva, the "Disconula," which, in possession of a marginal circlet of tentacles, has produced the individuals of the stock by gemmation from the subumbrella, and formed the starting-point for the development of the Discoidea (*Porpita*, *Veleva*), rechristened Discosnauthæ. By this hypothesis and the supposition involved in it of a diphyletic origin of the Siphonophora, Haeckel's theory certainly beomes *a new variety* of the Medusa-theory, but at the same time it loses probability in the same degree that the

* See Claus, "Ueber das Verhältniss von *Monophyes* zur den Diphyiden &c.," in *Arbeiten des Zool. Instituts &c.* (Vienna, 1883), p. 9.

new special assumption appears arbitrary and unfounded. From the two axioms follows the division of the Siphonophora into two primary divisions, which Hæckel denominates Siphonanthæ and Disconanthæ, and which, according to their origin, would be referred, the former to the Anthomedusæ and the latter to the Trachymedusæ. The inadmissibility of this diphyletic derivation has already been shown by another hand, and the contradictions have been indicated which would result for the structure and development of the *Veellæ* from the association with octoradial Medusæ*. It is not only that the stage of the radiate Disconula only follows upon a simply constructed bilateral stage of development, rendering it probable that here this is preceded by a bilateral division like that in Siphonanthan larvæ, but also the mode of origin of the mantle, which is by no means to be referred directly to the Medusan umbrella, as well as the development of an abundant vascular net and powerful muscular layer on the aboral surface, in contrast to the non-vascular and non-muscular exumbrella of the Medusæ, cannot be reconciled with Hæckel's views.

Against the Medusa-theory, however, in whatever form or modification it may be put forward, I have in my former paper urged another argument, which has been entirely ignored by Hæckel. I remarked that "another consideration renders it improbable that the sexual form of the Hydroid polyps in its perfect form furnished the starting-point for the production of the Siphonophora, *seeing that its ontogenetic origin is precluded by Hydroid-stocks, which consequently, even in a Medusa*† altered by dislocation of particular parts of the body and transformed into the stem-form of the Siphonophora, must have occurred in the development of the latter." "The direct development (without alternation of generations) of individual Hydroid Medusæ ‡ is, however, unquestionably only a subsequent secondary condensation of the developmental process, which, therefore, we are not justified in taking as the starting-point of the derivation." The Medusa-theory, however, commences with this subsequent, secondary, hypogenetic development of the stem-form, which is already repeated as a Medusa in the bilateral (Siphonula) or radial (Disconula) Siphonophoran larva, and consequently leaves the older and originally meta-

* Chun, Sitzungsab. der k. preuss. Akad. der Wiss. Berlin, 1888, Bd. xlv. pp. 3, 4. See 'Annals,' ser. 6, vol. iii. pp. 216-218.

† As supposed by Metschnikoff and also by Hæckel in his "Proto-meda."

‡ To these belong the Trachymedusæ and also, therefore, Hæckel's "Archimeda."

genetic development of the Medusa by Hydroid-stocks entirely out of consideration. That is the central and at the same time the weakest point of the theory, which at once brings the opposition to the Hydroid-theory into prominence. This commences with the older and original metagenetic development of the stem-form, and refers the resemblance to a bilaterally constructed Medusa which makes its appearance so early in the young Siphonophoran larva, only to external analogies secondarily produced. In this the Siphonophoran larva does not appear as the repetition of a primitive, *hypogenetically* reproducing, bilateral Oceanid with dislocated stomachal tube and marginal filaments, which by continued gemmation of new Medusæ and parts of Medusæ produces the polymorphic stock, but a free-swimming developmental stage of the Hydroid-stock of an Oceanid reproducing *metagenetically*, furnished the starting-point for the production of the Siphonophora, and in fact the prevention of fixation was the cause of the first change, the occasion of a series of transformations which then also affected the sexual Medusæ budding forth from the stock. Of course, in the absence of any data furnished by transitional stages and intermediate forms, it must be left to fancy to finish the picture of the changes through which in the phylogenetic process the original form resembling a larval *Hydractinia* or *Podocoryne* could have transformed itself into a Siphonophoran. It is only in this light that the attempt made in my little paper is to be judged, as a representation which, when compared with the picture of the budding Medusa, has at least an equal justification. The reconciliation between the Medusa- and Hydroid-theories which I attempted in this statement therefore depended upon the proof that, while for the former the conception of the Siphonophore as a polymorphic stock appears by no means excluded, the second theory also presupposes the presence in the stem-form of a Hydroid Medusa. I could approve of the Medusa-theory in so far as it starts from the Hydromedusa, but could not concede to it that this is to be found repeated even in the primary larva, and that the latter was to be palinogenetically interpreted. On the other hand, I defended the Hydroid-theory, in the conception of the polymorphic stock in which I found no contradiction to the former with reference to the starting-point of the Siphonophora, which is to be sought not in the mature Hydroid-stock, but in the free-swimming larval stock. The supposed stem-form was not a symmetrical Medusa with dislocated organs and hypogenetic development, but a metagenetically developing, normally constructed Medusa, in the swimming larval stocks of which the

starting-point of the production of the Siphonophore was recognized.

Consequently the two theories no longer stood by any means in *direct opposition*, as the *Polyorgan*- and *Polyperson*-theories, and were also brought nearer together in that in the case of the latter the derivation from the Hydroid Medusa might be accepted. Already it was attempted to clear up the mixture of truth and error, although in a different form and direction from Haeckel's Medusome-theory, and, indeed, in favour of the Hydroid-theory, which regards the Siphonophora as "swimming Hydropolyp-stocks" and deduces the resemblance of the larvæ to Medusæ from cænogenetically altered conditions. It was necessary to modify the original conception formulated by R. Leuckart only so far that in the room of the Hydroid-stock which after separation from its support adopted the pelagic mode of life and acquired a hydrostatic apparatus at its base now turned upwards, the swimming-larva, prevented from fixing itself but not affected in its nutrition, was placed, and, in agreement with the recently established views as to relation of the Medusa to the Polyp, the derivation of the Siphonophore from the Medusa as the sexual animal of the Hydroid-stock was recognized.

As regards the new Classification of the Siphonophora, on which Haeckel has based his work, its specialities follow directly as consequences of his hypothesis of diphyletic origin. The Siphonophora are raised into a class, and divided into two legions or subclasses with reference to their binary origin:—1. The SIPHONANTHÆ, derivable from the hypothetical *Protomeda*; and 2. The DISCONANTHÆ, originating from the hypothetical *Archimeda*. The first subclass is divided into the ordinal sections *Calyconectæ*, *Physonectæ*, and *Cystonectæ*, which correspond to the previously recognized groups *Calycophoridae*, *Physophoridae*, and *Physalidae*, to which are added, as a fourth order, the *Auronectæ*, a group of exceedingly remarkable deep-sea forms previously unknown. The second subclass contains the single order *Disconectæ*, which corresponds to the fourth Siphonophoran group, known as *Chondrophoridae* or *Discoideæ*. As the assumption of a special stem-form for the Discoideæ, which may be easily and naturally derived from the Physophoridae, seems neither necessary nor well founded, the alteration of the system founded upon it, which places the Discoideæ in an equivalent relation to the whole of the other groups, will have to be rejected as a novelty by no means justified by the state of the case. And we cannot deal otherwise with the many new denominations by which Haeckel, following his previous

custom, without any sufficient reason, wishes to make a number of old names which have obtained a footing in science disappear. Not only are new designations given to the orders and to many families and genera, but a new nomenclature is introduced, quite unnecessarily, for the parts and appendages of the Siphonophora.

In accordance with the fiction of the Medusome-notion all organs which may have originally belonged to a Medusa-person are comprised as a "Medusome," and palingenetic are distinguished from cænogenetic Medusomes. In the former the chief organs are considered to have remained more or less in their original connexion, while in the latter they have been more or less dislocated in consequence of cænogenetic displacement, and a secondary increase of homologous parts, a "multiplication" of the organs, has taken place. Groups of correlated Medusomes are denominated *cormidia*, and these are distinguished as *ordinate* (*Cormidia ordinata*) when they are repeated in metameric sequence, and *dissolved* (*Cormidia dissoluta*) when they are scattered on the stem and their organs are separated from each other. The swimming column is henceforth to be called the "Nectosome," the stem following beneath this the "Siphosome," the swimming-bell the "Nectophore;" the gastric sac or nutritive polyp is rechristened "Siphon," and the feelers (taster) "Palpons;" the filaments (*Fangfaden*) are called "Tentacles"*, the terminal threads on the urticating nodes "Tentilla," the subsidiary filaments of the taster "Palpacles," the tentaculiform appendage with a terminal aperture "Cyston," the covering pieces "Bracts," the taster or gastral tube bearing sexual buds "Gonostyle," and the sexual buds themselves "Gonophores." In the air-chamber or pneumatophore we find the air-sac denominated the "Pneumatossacus," the air-flask the "Pneumatocystis," its lower part which functions as a gas-gland the "Pneumadenia," and the basal aperture or funnel of this the "Pneumatopyle." That Haeckel makes a very

* In my writings I have repeatedly made use of the expression "tentacles" as synonymous with "tasters," just as the "feelers" of the Mollusca are usually called "tentacles." With Haeckel, who designates the "stinging filaments" as tentacles, this different use of the word leads to the following logical conclusion:—"Not unfrequently palpons are confused with tentacles, as, for instance, repeatedly by Claus, even in *Physophora*" ('Report,' pp. 17, 193, 260). A glance at my memoirs, and especially that on *Halistemma* (1878), will at once convince any one that I use "tentacle" as synonymous with "taster," and adopt the two denominations indifferently, so that there can be no question of a confusion with "stinging filaments." Moreover it is quite incomprehensible how any one could confound the "tasters" with the "stinging filaments," especially in *Physophora*.

extensive, indeed almost unlimited, use of his skill in making new and suitable names, is certainly intelligible from the fact that he possesses this faculty in a very high degree and has developed it, by many years' practice, into a speciality, in which at present no other naturalist can hope to equal him. But, although it cannot be denied that the introduction of new and appropriate names has many advantages, and is especially indispensable for the sake of conformity in the schematization of theory and system, it is, however, indisputable that by the continual accumulation of synonyms it leads to a nearly unlimited complication of nomenclature, causes much confusion, and instead of facilitating investigation renders it more difficult. It is therefore only in place when moderately exercised where the conditions absolutely require it, but when immoderately done without absolute necessity decidedly mischievous, and to be rejected at once when by it old, equally good names, which have become historical by the personality of meritorious authors, are displaced and removed from science.

However, our knowledge of forms has been extraordinarily enlarged by Haeckel's work, inasmuch as out of 240 species more than 60 were previously unknown, and these for the most part belong to new and interesting genera. By this astonishing enrichment of the materials the system must also have undergone a corresponding complication of form and abundance of divisions, and besides new genera new categories of higher rank, especially families and subfamilies, have had to be established. Unquestionably the special descriptive part, which is also of much greater extent, possesses a much higher value than the general or "philosophical" part, which is more aphoristically treated in the short introductory chapters, and which is intended to found the Medusome-theory and the system established upon it. Whether in the former the author has everywhere hit upon the right course and has not often gone too far may even now be justly doubted, and will be decided in the future by later investigations. There are numerous novelties in connexion with the division of pre-existing genera into two or more, and, indeed, on the ground of trifling distinctions scarcely applicable as generic characters. As examples may be cited the division of *Physalia* into *Physalia* and *Caravella* and of *Alopleota* into *Alopleota* and *Arethusa*, as also the establishment of two subfamilies associated therewith; further the breaking up of *Rhizophysa* by its different species into the genera *Aurophysa*, *Cannophysa*, *Linophysa*, *Nectophysa*, *Pneumophysa*, and *Rhizophysa*, and

the distinction of two subfamilies as Cannophysidæ and Linophysidæ upon differences which perhaps justify generic separation. The same thing applies to the splitting of the genera of Agalmidæ so far as in their foundation the form of the tentilla is exclusively taken into account (*Agalmopsis*—*Lychnagalma*; *Halistemma*—*Cupulita*; *Anthemodes*—*Cuneolaria*; *Agalma*—*Phyllophysa*; *Stephanomia*—*Crystallodes*).

Further, it seems to me quite unjustifiable to establish a special order of Siphonophora for the remarkable deep-sea genera *Stephalia* (*Stephonalia*), *Auralia*, and *Rhodalia*, as these forms possess the pneumatophore of the Physophoridæ (Physonectæ) and have only acquired the character peculiar to them and by which they take their place as a special group of Physophoridæ by the union of the proximal section of the pneumatophore with an air-discharging apparatus (aurophore). That the peculiar apparatus designated an *aurophore* has been produced by the transformation of a nectocalyx is not only not proved, but is even very improbable, as we cannot very well see how a nectocalyx could have got upon the dorsal line of the stem, which is always destitute of buds. Even if this remarkable pneumoduct should be superinduced, in analogy with the foundation of the nectocalyx, by a bud-like elevation of the two cell-layers of the stem with subsequent growth of the entoderm and invagination of the surrounding entoderm, this would by no means prove that it was actually produced by transformation of a nectocalyx, but it would be much more justly interpreted as a special differentiation of the wall of the stem at the air-funnel of the pneumatophore in connexion with the necessity of the escape of air. However, even in the first case there would be no reason for the establishment of a special order.

Another much heavier criticism relates to the classification of the Calyphoridæ (Calyconectæ), under which the Eudoxidæ and Ersæidæ with their genera and species figure as distinct families side by side with the Monophyidæ and Diphyidæ. It is, in fact, a fundamental offence against the idea of a natural system constructed upon a phylogenetic foundation to separate the sexual generations which have become independent from the generations which produce them and to treat them as distinct species of distinct genera and families, to be arranged and enumerated as equivalent to the corresponding categories of the nursing generations. No fewer than 25 species, 8 genera, and 2 families in consequence occur twice over and under two denominations. In point of fact such a duplication of equivalent categories would con-

vert the natural system, based upon genealogy, by the dislocation and repetition of related members, into an artificial mosaic patchwork. If the example here given by Haeckel were to be accepted and imitated we should soon come to have an analogous alteration of the classification of the Cestodea, for example, put forward as a consistent advance, in accordance with the spirit of the times. Following the present pattern distinct families would first of all be established for the Proglottides and Strobila-forms, and then also for the Cysticeri, and by the analogy of the dislocation and multiplication of organs divided into families, genera, and species. It is difficult to find a reasonable ground which can have induced the author to make so inconceivable a logical mistake. Was it conformity of arrangement that ruled the scheme of classification? The other orders commence with monogastric families, the Physonectæ with the Cirralidæ and Athoridæ, the Cystonectæ with the Cystalidæ, the Disco-nectæ are exclusively monogastric Siphonophora, and so monogastric families must come at the head of the Calyconectæ. However, the unequal values of the monogastric families ought to have attracted attention, inasmuch as in those orders they represent the simplest and, in development, the oldest genera, whereas the Eudoxidæ and Ersæidæ, as metameric fragments equivalent to the so-called Prodoxiæ of the polygastric Apolemiadæ, represent the final terms of the evolution.

How far the changes relating to the nomenclature of the genera and families are justified shall not be further discussed here, only a deviation from the old-established practice which Haeckel has permitted himself, as in previous writings, in his *System of the Siphonophora*, may be mentioned and rejected as inadmissible. This relates to the perfectly new proceeding of striking out the name of the author in the case of already known species established by previous authors on the ground of a change in the generic designation, placing in its stead the name of the author of the new genus. This is a licence which, so far as I know, no other naturalist allows himself, one of Haeckel's peculiarities which, in conjunction with the principle of splitting the genera into new ones upon unimportant differences previously used only for the distinction of species, opens to the "mili" of the systematist a glimpse of a new and exceedingly fertile field.